Integrated Facilities System Enterprise Strategy

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US Army Corps of Engineers.

Integrated Facilities System Enterprise Strategy

INTRODUCING THE VISION

This document describes the vision for future technical development of the Integrated Facilities System (IFS).

THE PURPOSE

The purpose of the *Integrated Facilities System Enterprise Strategy* is to describe an evolution strategy for IFS to support U.S. Army installation Directorates of Public Works (DPWs) into the 21st century. The IFS Enterprise Strategy aims to help focus Army efforts to maximize benefits to DPWs, Army Staff (ARSTAF) and ultimately the warfighter.

The Strategy will:

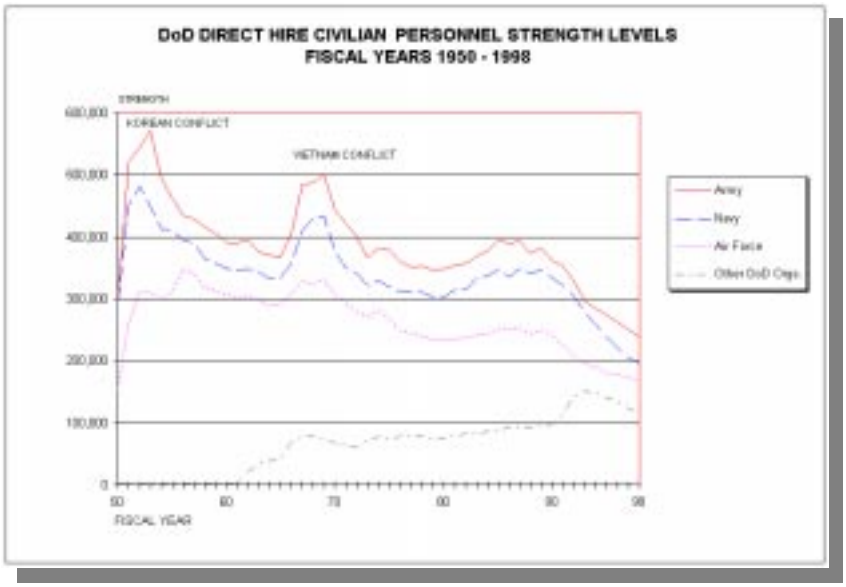
- Help unify DPW communities toward common goals
- Establish a structure to help guide the future direction of IFS
- Develop functional and technical guidelines to aid functional proponents, IFS users groups, system developers, researchers, contractors and the IFS Configuration Control Board (CCB) in making system assessments and strategic decisions
- Align the strategic focus and guiding principles with other existing strategic efforts such as Joint Vision 2010, Army Vision 2010, Installation Vision 2010, the Army Strategic Management Plan and the Army Electronic Commerce Strategic Plan.

THE NEED FOR CHANGE

General business trends occurring in the DPW and other Army agencies are driving the need for change in business processes and automation support related to Army installation public works. In some cases these trends are prevalent in government and commercial business environments worldwide.

In part, as a result of the Federal policy and guidance set forth in the August 1983 Office of Management and Budget (OMB) Circular No. A-76, "*Performance of Commercial Activities*," most DPWs have experienced a steady decline in Federal personnel strength during the last several years. This trend is likely to continue as more DPW recurring commercial activities are operated via contract with commercial sources, privatization or interservice support agreements

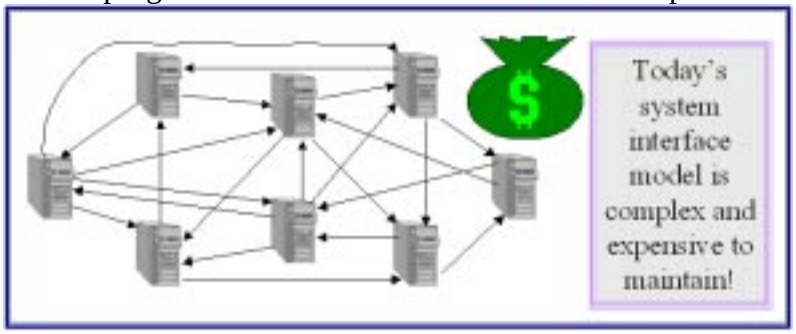
(ISSAs). While the Government may gain efficiencies by outsourcing certain DPW commercial activities, an unfortunate trend associated with the loss of Federal personnel is the accompanied loss of Army institutional knowledge – a potentially invaluable asset for a DPW's most efficient organization (MEO). Improved capabilities for capturing and sharing institutional knowledge is needed.



As more DPW operations are outsourced, the nature of work for many Federal DPW employees will likely change with more emphasis placed on work estimating, work inspection, contract management and communicating with customers regarding requirements, expectations and work status. As they perform their daily tasks, many DPW employees and partners will find it increasingly necessary to make informative business decisions based upon information and knowledge gathered from disparate government and commercial database or document management sources.

Changes in the nature of work will coincide with changes in automated tools used to support the work. Software developed and maintained by the Army will continue to be used to support functions subject to unique Army business rules. However, to achieve software economies-of-scale, the emphasis for DPWs, contractors, privatization partners and ISSA agencies to use commercial, off-the-shelf (COTS) software wherever possible will continue.

Today the Army uses many database management systems (DBMSs), or on-line transaction processing (OLTP) systems, to conduct day-to-day business. Over the years, many custom program interfaces have been developed to share data between DPW OLTP systems for reporting and other purposes, and there is a demand for more interfaces. Once developed, these custom program interfaces are often difficult and expensive to maintain since changes to one or more custom program interfaces may be required each time a related OLTP database schema changes.



Ubiquitous use of COTS software introduces new challenges regarding interoperability of systems that were never designed

to work together in an operational sense. Often these systems do not conform to Army business rules, nor do they always provide usable decision-support information. New, more cost-effective methods for achieving operational integration of systems need to be applied. A standard approach for capturing, storing and retrieving decision-support information from Government and COTS software is needed along with enhanced decision support tools.

> "Army XXI will be a fully integrated, digitized force using commercial information technologies to support total situational awareness and total asset visibility."
>
> "Digitization for the installation commander and how he uses that information differs only slightly from the requirements of a field commander."
>
> *Installation Vision 2010*

A DPW that works better with fewer resources requires efficient and effective information systems. The hardware and software used by DPWs must become more scalable and at the same time secure and easier to maintain. A scalable computing platform implies that it will support growth in the amount of data or information managed, the number of users supported and the types of functionality supported so that information and knowledge management systems can grow and adapt as quickly as the DPW's organizational needs increase and change. With fewer DPW in-house automation support resources, on-site system maintenance requirements for the DPW must be kept to a minimum and on-line system support must be more readily available.

One of the eight goals defined in *Installation Vision 2010* is "Power Projection." One strategy that relates to this goal is "Army support of information dominance programs." This strategy emphasizes the importance of an installation commander having current and accurate information in a digitized format to manage assets and make decisions most efficiently and effectively. One way IFS may better help achieve the Power Projection goal is to provide an installation commander and others the ability to synthesize, visualize and interpret facility data more rapidly. Such improvements may be accomplished by seamlessly linking IFS tabular data having "location" references to spatial data contained in computer-aided design and drafting (CADD) drawings and geographic information systems (GISs).

Today many of those involved in Army installation public works are often not found at a desk or even in a building. They are on the move, traveling from one job-site to another, sometimes at more than one installation, to meet with customers, complete a work order, inspect work, or assess and solve problems that require immediate action. It is foreseen that during the next few years those involved in Army facilities management and support will spend even more time working outside the office, away from desktop personal computers (PCs) physically connected to local-area networks (LANs). To be most productive, DPW employees, hired contractors and ISSA personnel need to be able to enter and retrieve IFS information remotely. It's likely that the issue of remote access to IFS information will become

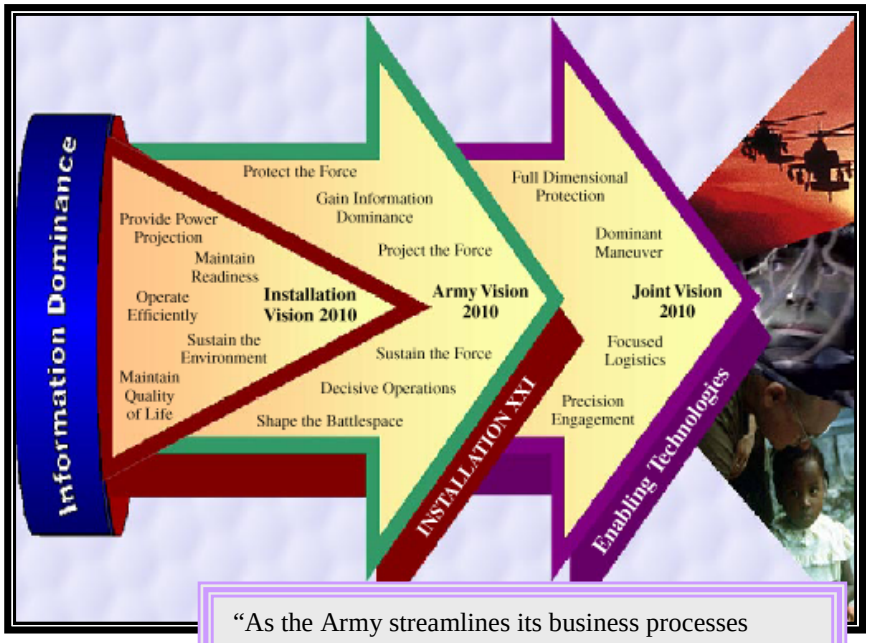
even more important to DPW operations as U.S. Army Corps of Engineers (USACE) Installation Support Offices (ISOs) mature.

Entry of facility management data into IFS can sometimes be a tedious task. This is especially true if one often works outside the office, removed from a personal computer (PC) that's connected to IFS. When in the field, one might temporarily record facilities management data on blank paper, printed forms or electronically using spreadsheet, word-processing, or custom-developed software. Upon returning to the office, the task of entering into IFS the relevant data recorded in the field begins. This scenario suggests room for process improvement if somehow data could be captured electronically while in the field using a portable data acquisition device, and then easily uploaded into IFS once it's convenient.

There are perhaps many other compelling examples that demonstrate the changing nature of the challenges faced by DPWs. The functional problems that have been discussed in this section point us in new directions that our facilities management business-practice and automation capabilities must take.

THE WAY FORWARD

Solving today's and tomorrow's problems and challenges in Army installation public works demands that the Army focus on providing the best training, business policies and practices, information systems and enterprise knowledge to the DPW.



> "As the Army streamlines its business processes using Business Process Reengineering (BPR) techniques and leveraging Electronic Commerce (EC) technologies, the Army EC program will enhance its ability to realize the Army Vision 2010."
>
> *Army Strategic Plan for Electronic Commerce*

The Army's *Installation Vision 2010* outlines tenets, goals and strategies that Army soldiers and civilians should embrace to reach new levels of effectiveness for the installation as a warfighting component. The IFS Enterprise Strategy is the blueprint of the way forward for Army public works management towards leveraging technology to help the Army achieve its goals of *Power Projection*, *Installation-Level Smart Business Processes* and *Resource Management*. While moving forward to provide optimal solutions, ten IFS Enterprise Strategy Principles will be adhered to and used as guidance by the IFS Program Manager, Configuration Control Board (CCB), system developers, researchers and end-users.

IFS ENTERPRISE STRATEGY PRINCIPLES

Focus on the DPW

Provide DPWs the support, automated systems and business process procedures that meet validated, customer-focused needs.

Leverage Commercial Technologies

Provide IFS users enhanced capabilities to perform their tasks using integrated hardware and software solutions that exploit commercial technologies.

Implement Scalable Computing Architecture

Provide IFS users a computing platform that's easy to use and support, and allows for future growth by exploiting World Wide Web (WWW) technologies.

Enhance Decision Support

Provide the DPW and others the capability to store, manage and retrieve decision support information.

Improve Operational Integration of Systems

Provide means to interface Government and COTS systems that de-couples rates of system evolution.

Integrate IFS with CADD and GIS

Provide the ability to view, analyze and interpret location-referenced IFS data using COTS computer-aided design and drafting (CADD) or geographic information systems (GISs).

Introduce New Data Acquisition Methods

Provide the DPW the capability to acquire IFS data using several types of data collection devices.

Exploit Wireless Communication Technologies

Provide the DPW the ability to enter and view public works information remotely via wireless data networks.

Capitalize on Corporate Lessons Learned

Provide IFS users an integrated capability to record and share task-specific lessons-learned throughout the Army.

Maintain IFS Customer Support WWW Site

Provide IFS users support for software and business processes via an IFS WWW site.

Focus on the DPW

Provide DPWs the support, automated systems and business process procedures that meet validated, customer-focused needs.

Since its inception, the Integrated Facilities System (IFS) has focused on serving Army installation Directorates of Public Works (DPWs). The IFS Enterprise Strategy continues the commitment to provide the DPW automated systems aligned with efficient business processes that meet validated, customer-focused needs.

Over the years, automation needs of the DPW have changed and so has IFS. To better service the DPW, IFS has migrated from a batch-processing system, to a full Windows®-based client/server application. Many incremental changes to IFS, too numerous to mention, were made along the way.

Several new features are now being planned and developed for IFS to meet current and future requirements:

- In 1990, Public Law 101-576 introduced the Chief Financial Officer's Act (CFOA) that requires the Federal government to practice more effective financial management, including the integration of financial and functional management systems. The system selected by the Department of Defense (DOD) to manage property accountability and financial reporting is the Defense Property Accountability System (DPAS). A program interface between IFS and DPAS will be created and maintained, helping the Army meet financial management obligations and streamline related business processes.
- Anticipating that the DPW in-house workforce will perform less hands-on engineering or operation and maintenance (O&M) activities and instead focus more on contract operations and business management, a new Contract Management System (CMS) is being developed to replace the current IFS Contract Management module. CMS will offer several new features, enabling more accurate

capture and management of project data in line with the way DPW engineers, technicians and inspectors perform their jobs.

- A new Automated Labor and Equipment Card (ALEC) module is planned for IFS. Recording and entering labor and equipment (L&E) cost data associated with maintenance and repair activities into IFS from the field has long been a time-consuming and error-prone process. Several years ago, a standalone version of ALEC was developed to run in the MS®-DOS operating system environment. Utilizing barcode technology and portable barcode scanners, this early version of ALEC successfully demonstrated the benefit of automating L&E data collection and entry. ALEC is now being reprogrammed to be fully compatible with Microsoft® Windows and completely integrated into IFS. The new ALEC will allow users to chose among a variety of field data collection devices such as barcode wands and palm computing devices.
- Commercial, off-the-shelf (COTS) work-estimating and supply management software applications are being integrated into the IFS environment to enhance the DPWs' capabilities in those arenas.
- IFS Application Program Interfaces (APIs) are being developed to make it easier to create and maintain program interfaces between IFS and COTS or custom-developed software.
- A new IFS real property module that uses World Wide Web (WWW) technologies, including a Web-browser interface, will be released soon, making real property management tasks much easier.

To remain competitive, DPWs will continue to change. Changes in installation support business practices will lead to changes in information requirements. Functional enhancements and additions will be made to IFS in concert with DPW changing business practices, making IFS an integral part of a DPW's Most Efficient Organization (MEO) automation strategy. Some DPWs will change faster than others. IFS will migrate towards a more flexible computing environment that will allow each DPW to tailor IFS to meet their specific needs.

IFS is a Standard Army Management Information System (STAMIS) currently comprised of a database, a blend of government-developed and COTS applications that address the different DPW business functions, and custom program

interfaces to other STAMISs. The IFS database is the Army's "*database of record*" for real property and manages information on many other aspects of facilities engineering activities. Government-developed application modules handle real property, work management, job-cost accounting and contract management, while COTS applications deal with work estimating and supply.

In the future, it's expected that COTS software will play a larger role in the IFS environment, handling the work management and job-cost accounting functions. Due to legal and regulatory requirements for real property accountability that are unique to the Federal government, the IFS database will continue to serve as a transaction system for real property. However, IFS will also act as an *operational data store* (ODS), facilitating the sharing of data between one COTS facilities management application and another, or between COTS software and custom government systems. In general, an ODS is a database that serves as a "staging area," or hub, for data that must be shared. A transaction system that needs to share certain data with other systems can periodically send that data to the ODS. Then when one transaction system needs data from another system, it retrieves that data from the ODS, not from the transaction system where the data originated. The ODS approach for achieving system integration effectively provides relief from using many custom program interfaces between systems, a practice that spawns a "spaghetti" network of program interfaces that ultimately is costly and difficult to maintain.

While these changes planned for IFS are primarily focused on the needs of DPWs and their installation customers, those at Army headquarters and other Army agencies will also benefit from improved efficiencies and availability of more timely facilities management data of a higher quality than ever before.

IFS Today

Oracle® Database
- Transaction database

Government-Developed Modules
- Real property
- Work management
- Job-cost accounting
- Contract management

COTS Applications
- Work estimating
- Supply

Utilities
- Custom program interfaces to other STAMISs

IFS Tomorrow

Oracle Database
- Transaction database
- Operational Data Store

Government-Developed Modules
- Real property
- Contract Management System

COTS Applications
- Work estimating
- Supply
- Work management
- Job-cost accounting

Utilities
- Custom program interfaces to other STAMISs
- Application Program Interfaces

Leverage Commercial Technologies

Provide IFS users enhanced capabilities to perform their tasks using integrated hardware and software solutions that exploit commercial technologies.

Today's high rate of progress of commercial technology is unprecedented. Worldwide demand for advanced technologies has led to very affordable commercial, of-the-shelf (COTS) hardware and software. In designing the future Integrated Facilities System (IFS) environment, it is the Army's goal to exploit COTS technology to the maximum extent possible and reduce the Army's development and support of custom software.

Since the Army has limited resources to apply to any automation support system, the challenge will be to select key technologies for use and deployment that have widespread application and that yield the highest returns on investment. In the near term, functional improvements in IFS will be made by introducing new COTS work-estimating and supply-management software applications into the IFS framework. Over time, new COTS software and hardware will be added to IFS to improve IFS users' capabilities and reduce IFS life-cycle management costs.

Due to unique Army business rules, some DPW automation requirements will not be able to be satisfied by COTS technologies. To address these requirements, the Army will continue to invest in research, custom software development and system support. The design approach for IFS will emphasize hardware and software modularity and a published open architecture, allowing simple upgrades and development of IFS add-on software and hardware components by any government agency or commercial company.

To help avoid system compatibility problems and reduce support costs, the IFS life-cycle management plan will call for timely disposal of obsolete COTS equipment and software as new technology or version upgrades become available.

To help DPWs take full advantage of COTS technology, efforts will be made to simplify the acquisition process for obtaining IFS COTS hardware and software.

Implement Scalable Computing Architecture

Provide IFS users a computing platform that's easy to use and support, and allows for future growth by exploiting World Wide Web (WWW) technologies.

Over the years, the IFS system migration path may be characterized as having three main phases:

- A dedicated minicomputer was used at each installation to store and process all IFS data. IFS users used personal computers (PCs) or dumb terminals that were directly connected to the minicomputer to enter and view data and print reports.
- A UNIX workstation was used at each installation as a dedicated server for storing IFS data and handling all computer processing. IFS users used PCs that connected to the IFS server via a local-area network (LAN) to enter and view data and print reports.
- Today IFS uses a two-tier, client/server architecture in a LAN environment where a dedicated UNIX server stores the IFS database while IFS application software resides on client PCs. Computer processing management is split between the server and the many clients, where the server handles IFS database management, providing stored procedures and triggers, and the IFS application logic runs on client PCs.

Each time IFS migrated to a new computing environment, IFS users experienced increases in system performance and the life-cycle costs borne by the DPW declined. Today's IFS environment also offers significant improvements in functionality over its predecessors.

With increasing customer demands and a general decline in DPW resources, consideration of the next phase along the IFS migration path is imperative. A more versatile, modular and cost-effective system architecture is needed for IFS that will improve *usability*, *flexibility*, *interoperability* and *scalability*. This architecture should reduce the need for system training, allow software developers to change the system more easily and support sharing of data with other systems. As a scalable system, it should also be able to adapt quickly to new user requirements such as increases in the amount of data managed or the number of system users, or changes in the business functions served.

Consistent with the Clinton Administration's *Access America* plan, the next-generation architecture for IFS will exploit Internet and World Wide Web (WWW, or "Web") technologies to meet organizational needs. *Access America*, announced by Vice President Al Gore in February, 1997, instructs Federal agencies to digitize more information and increase access to government services via the WWW.

Usability: the ease with which a user can learn to operate, prepare inputs for, and interpret outputs of a system or component.

Flexibility: the ease with which a system or component can be modified for use in applications or environments other than those for which it was specifically designed.

Interoperability: the ability of two or more systems or components to exchange information and to use the information that has been exchanged.

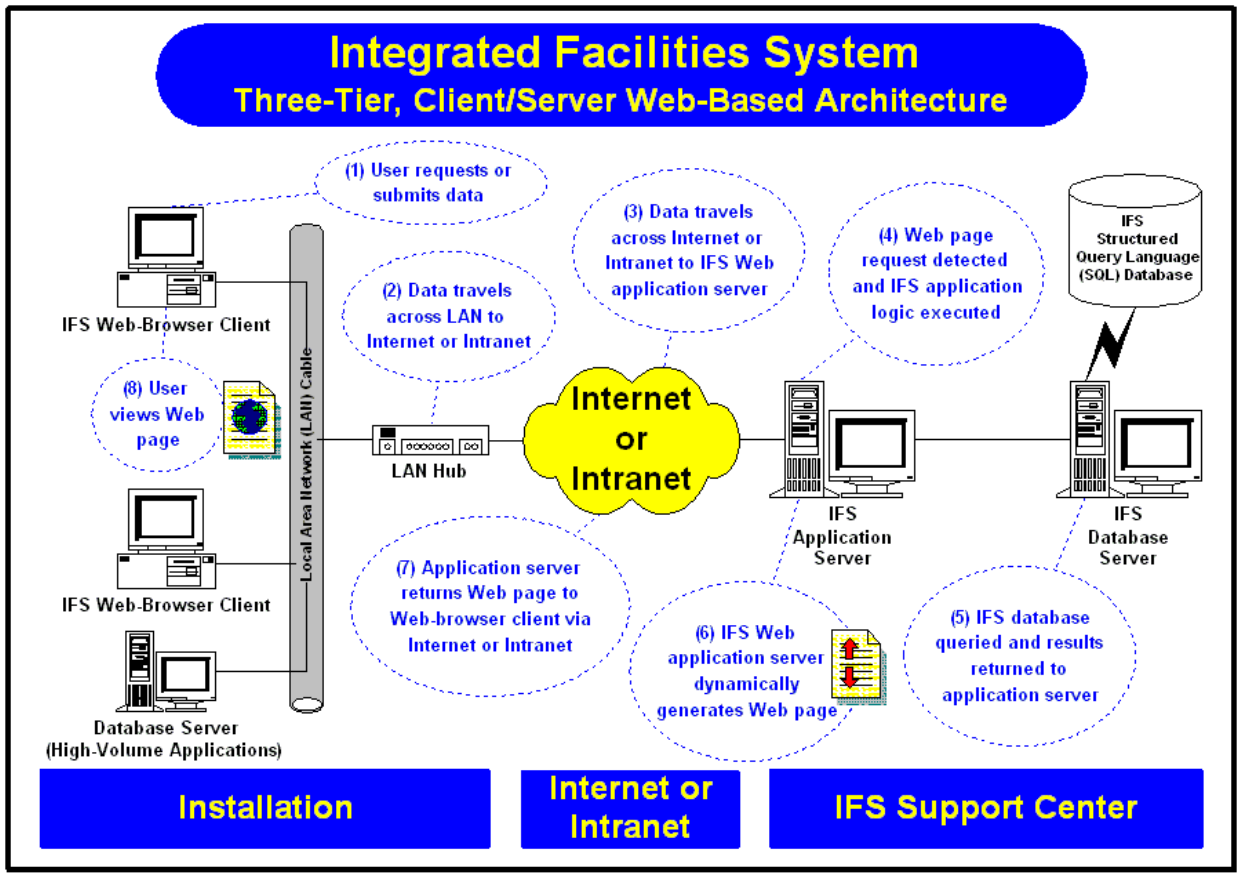
Institute of Electrical and Electronics Engineers (IEEE) Standard Computer Dictionary: A Compilation of IEEE Standard Computer Glossaries, (1990)

IFS will use a three-tier, client/server architecture that consists of three well-defined and separate processes, each running on a different platform:

(1) The user's system interface will be a Web browser. The Web browser software will reside and run from the user's PC, i.e., the *client*.

(2) Web server software and government-developed IFS functional modules that process data will run on a second tier called an *application server*, where the Web server and IFS application logic executes.

(3) The third tier, a *database server*, will store the IFS database of record and process database stored procedures and triggers.



The added modularity of a three-tier design makes it easier to modify or replace one tier without affecting the others, and separating application functions from database processing helps ensure that no single platform becomes overloaded with information processing. Should the DPW have concerns about data security, system reliability or data storage for high-volume applications, this design does not preclude certain IFS modules or other multi-user software applications from running locally on an installation's LAN.

This architecture offers the DPW and its customers several new functional opportunities and advantages:

- Because of the scalable architecture, IFS data for all installation DPWs may one day reside on a single database server at one location, abolishing the need for DPWs to expend resources to have and maintain IFS database-server hardware and software. The technology exists today to establish a single IFS database server to service day-to-day transactions for all DPWs Army-wide. Amazon.com®, Inc.'s, and Microsoft Corporation's TerraServer Web sites are evidence for this claim. Amazon.com boasts that Web transactions by 10 million people in more than 160 countries have made them the leading online shopping site. The TerraServer world imagery database is the largest database on the Internet. At 1.01 terabytes in size, TerraServer manages over 301.5 million data records and 4.1 terabytes worth of uncompressed aerial photographs and satellite images.
- New, IFS client software will no longer have to be installed on the PC of every IFS user each time an IFS System Change Package (SCP) or Interim Change Package (ICP) is delivered. Instead, IFS application software upgrades will be installed on the IFS application server, making system updates instantly and consistently available Army-wide to every IFS user. In general, software upgrades for IFS client PCs will be limited to new releases of commercial, off-the-shelf (COTS) Web browser software, security-related and other software patches for the Web browser, or updates to other COTS software that are not Web-enabled.
- If at any time the IFS application server becomes frequently overwhelmed with data input or requests from users causing the system performance to reach unacceptable low-levels, one or more application servers can be added to boost system performance. Using two or more application servers permits load balancing, where one server that's too busy can forward users data-processing requests to another server that has more computing capacity.
- New IFS users will be able to learn the system with less training than before. It's estimated that now over sixty million U.S. citizens have access to the Internet. Since there's little variation in how Web browsers and applications look and behave, it's anticipated that most IFS users will quickly adapt to a Web-based IFS with little or no training.
- Advanced usability can be achieved. For example, whenever a given user accesses IFS, the system could instantly recognize who that user is and dynamically create Web pages to display forms, system menus and information tailored specifically for that individual.
- IFS data could be made available for different kinds of users. Types of users may include DPW customers interested in checking the status of work orders that they entered into IFS from their offices or homes, contractors and privatization partners that may need limited access to IFS for various reasons, local municipal employees who work closely with an installation, or even the general public. Web-browser encryption and IFS database security features ensures a secure Web-based environment. Announced January,

"*Access with Trust*, describes an essential technological and institutional means of fostering safe, secure electronic interactions, a Public Key Infrastructure (PKI). *Access with Trust* focuses on how the Federal government will promote and use a PKI to safeguard and protect electronic interactions internally (among Federal government employees and agencies) and externally (between the Federal government and its many trading partners-state and local governments, businesses, and individuals)."

Greg Woods
Chair, Government Information Technology Services Board

1999, the Clinton Administration's *Access with Trust* initiative that promotes Public Key Infrastructure (PKI) technology promises even more security for Internet services.

Advantages of a scalable, Web-enabled computing architecture are perhaps too numerous to mention. As IFS incrementally evolves to this architecture, additional advantages will become apparent. The first step towards this architecture will be the redesign of the IFS Real Property module, making it Web-based in the near future.

Enhanced Decision Support

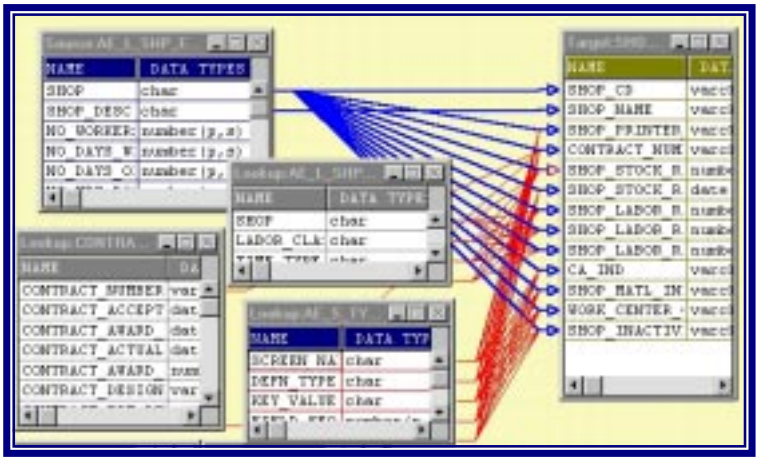
Provide the DPW and others the capability to store, manage and retrieve decision support information.

Essentially, the Integrated Facilities System (IFS) application may be defined as an operational, or on-line transaction processing (OLTP), system that helps Directorates of Public Works (DPWs) with the life-cycle management of real property resources at U.S. Army military installations. IFS is a Standard Army Management Information System (STAMIS). The IFS database is "*the database of record*" for an Army installation's real property assets. Besides maintaining information for many aspects of facilities engineering activities that DPWs rely upon daily to conduct business, IFS serves as a single-source database of facilities-related and budget-supportive information used by managers at all levels of installation command, major Army commands (MACOMS) and Headquarters, Department of the Army (HQDA).

As IFS evolves over time, fewer resources will be devoted to custom development of the IFS operational system. Instead, a relatively higher percentage of available resources will be devoted to developing an enhanced capability for the Army to make facilities-related, strategic business decisions at all Army levels. This capability will be achieved primarily through the implementation of a data warehouse architecture and a DPW Enterprise Information Portal (EIP).

> "A data warehouse is a subject oriented, integrated, nonvolatile, and time variant collection of data in support of management's decisions."
>
> *W.H. Inmon*
> *Author of "Building the Data Warehouse"*

Data warehousing has become very popular among organizations seeking to use information technology to gain a competitive advantage. Data warehousing improves overall access to corporate data and serves as a catalyst for business process improvement. Basically, a data warehouse is a single, complete, and consistent store of data obtained from a variety of operational sources that is accessible to end users in a way that can be understood in a business context.



The IFS database will be one of several source databases for the DPW data warehouse "target" database. Other source databases will include those of commercial, off-the-shelf (COTS) software that's integrated with IFS, other STAMISs used by the DPW, and contractor proprietary systems. Periodically, certain data will be extracted from these source databases and moved to the DPW data warehouse. This data extraction

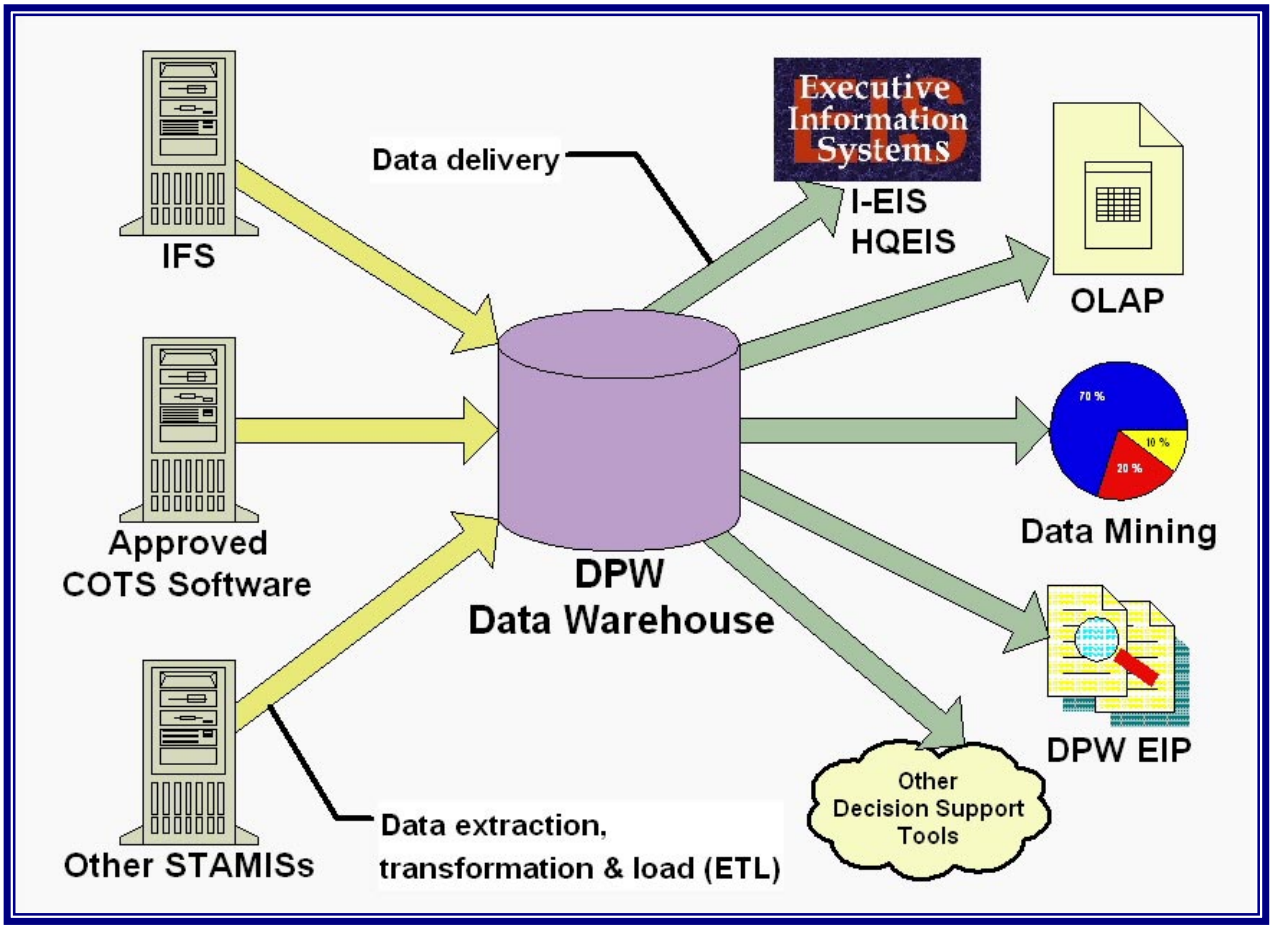
will occur automatically per a defined schedule for unique, subject-oriented "*mappings*" of data. Many data mappings may exist, each capable of having their own data extraction schedule. Much of the data that is extracted from IFS and other source databases will be transformed in some way. For example, detailed information may be extracted from IFS and other source databases and transformed into summary information that is frequently requested by DPW and other Army managers. Typically, the summary information is the data actually written to the data warehouse. Unlike data in an operational database which may change frequently, data written to a data warehouse is nonvolatile, or static, and has a time dimension, i.e., each data point is associated with a point in time.

Management of facilities-related, summary information in a data warehouse can dramatically improve information access and quality for several reasons:

- The data warehouse provides a single image of business information by integrating data from disparate sources.
- Access to summary information is relatively much faster since users query the data warehouse database where summary values for reports already exist, relieving users from having to wait for complicated operational database queries.
- Data warehouse queries from users do not interfere with normal business operations of a transaction system. Data extractions and transformations from transaction systems can occur during idle work periods.
- The data warehouse metadata, i.e., data about data, is generally more descriptive and stable than metadata associated with COTS or legacy operational systems where changes in database schemas occur often in response to changing business needs.

Many standard and ad-hoc reports can be generated from data warehouses. In addition, data warehouse information can be delivered to the Army's Installation Executive Information System (I-EIS) and Headquarters IFS EIS (HQEIS). However, perhaps the most interesting aspect of a data warehouse is the interface between a user and an online analytical processing (OLAP) or data mining tool. It is with these tools that Knowledge

Discovery in Databases (KDD) occurs. With KDD software, users can find previously unknown patterns and trends in data that can eventually result in actionable business decisions. Industry trends indicate that future releases of many COTS database management systems (DBMSs) will have a rich set of KDD tools integrated into the DBMS, making knowledge discovery in the data warehouse easier.



Complimentary to the data warehouse architecture is the notion of providing the DPW an Enterprise Information Portal (EIP) for securely accessing decision support and other business intelligence information. In general, a portal may be defined as a Web site, or Web-based service, that offers a broad array of resources and a cost-effective, corporate approach for sharing organizational knowledge. Examples of World Wide Web (WWW) portals include Yahoo!®, Lycos®, Infoseek's GO Network™ and Excite.

Besides serving as a platform for delivering data warehouse information to end users, the DPW EIP will be a single framework for dynamically organizing and presenting corporate information from a variety of disparate sources of different forms. Examples of forms of information that the DPW EIP will manage include desktop office-suite documents, portable document format (PDF) files, multimedia files, computer-aided design and drafting (CADD) drawings, geographic information system (GIS) images, and links to Intranet or Internet sites.

Basically, the DPW EIP will handle two primary functions: (i) indexing, cataloging, and categorizing corporate data, and (ii) presenting information to individual users in a Web-browser view. The DPW EIP will be designed with several important features:

- Effective use of metadata to help users understand the information in an appropriate business context.
- Context-sensitive searches to help users quickly find information.
- The ability to distinguish between different users to allow for custom views of only the information that's appropriate to the designated, registered user.
- Advanced administrative capabilities that will allow such things as global portal content and security privileges to be managed by a non-technical person.
- The ability to adapt to changing business requirements without computer hardware or software modifications.

As DPW business gets increasingly distributed among government employees and commercial contractors, as workers become more geographically dispersed and are required to perform more of their jobs with the aid of technology, it makes more and more sense to have data warehouses and Web portals to improve knowledge management and productivity.

Improve Operational Integration of Systems

Provide means to interface Government and COTS systems that de-couples rates of system evolution.

In the past, Directorates of Public Works (DPWs) were provided new automated capabilities within the Integrated Facilities System (IFS) environment by custom developing new or enhanced IFS modules as requirements surfaced. However, recent developments in commercial software and supporting operating system infrastructure now allow for relatively easy integration of commercial off-the-shelf (COTS) software in IFS. By using an Application Programming Interface (API)-based approach, common data processing functions found in commercial software can be exploited, thus saving limited IFS development resources for DPW-specific requirements.

An Application Program Interface (API) is a "standard" for how to access data and procedures belonging to some application or group of applications. Access is achieved in a programmatic way rather than using public (i.e. published) database schema.

A key advantage to such an approach is that the developer of the API maintains control on allowable modes of access to data and services. This is an important advantage in maintaining the integrity of the underlying information. For example, you can allow other programs (and, by inference, users and/or programmers) varying levels of access to IFS data and services based on their authentication level. Approved applications can be granted change access to the data through the API such that the IFS business rules must still be satisfied. Applications that attempt to make invalid manipulations will receive error signals at the time the attempt is made. Contrast this situation to that of a published database schema which allows a change that is within referential integrity or other rules stored within the database, but not in accordance with IFS business rules encapsulated in code. The change would be allowed, only to generate errors later on in IFS or other applications that rely on the business rules having been enforced--unless extraordinary (and often redundant) measures are taken to validate the data before each use.

Another advantage to API-based application integration is that it allows for the de-coupling of the rates of evolution of the elements being integrated. For example, a change in one program's data schema does not require another program to be rewritten. A well-designed API is generally more stable than the underlying data schema--it will not need to change often, if at all. This stability eliminates "trickle-down" effects across applications when one application is upgraded before others in the integrated suite. In other words, application versions need not be synchronized—they need only to reference a common API by which data and services can be exchanged. In all other regards, each application evolves distinctly from others in the suite.

Similar benefits accrue due to the fact that an API-based approach promotes code reuse. Since developers target the API rather than specific applications, new applications can be brought online and interact with existing applications without re-writing any of the pre-existing

applications. This flexibility extends the life of an existing code base, and reduces costs because code reused is code that does not have to be written when a new requirement emerges.

A final example of benefits associated with API-based code integration is that it offers more developers an opportunity to innovate around the core application (in this case, IFS). A well documented, stable API facilitates third party extensions as commercial vendors can write to the published API. Additional flexibility is afforded to government organizations that can develop interfaces between COTS packages and the API, thereby making the exposed functionality of the COTS package accessible to all applications that support the API. Further, a COM (Component Object Model)-based API can be accessed via standard productivity packages such as Excel using VBA (Visual Basic for Applications).

The Component Object Model (COM), created by Microsoft, is a descendant of OLE (Object Linking and Embedding), and is “built in” to Windows 95, 98 and NT. Part of the underlying infrastructure of the Microsoft 32-bit operating systems, COM is a framework that allows sophisticated representations of data and business logic (objects) to be shared between applications. An extended version of COM (DCOM, where the D stands for "distributed"), extends this capability to multiple machines over a network. COM+ is the next generation of COM/DCOM just now hitting the marketplace.

COM is an important technology in that it allows for the creation of APIs that were not possible just a few years ago. Previous attempts at API-based software integration in the late 1980's and early 1990's suffered from the lack of a standardized, generally available way to express data and procedures (objects) between applications. While object-oriented programming techniques were available within a single application, there was no way for one software package to share its objects with another directly. The result was "integration" based on least common denominators--flat data files generated on the fly or "standardized" database schema.

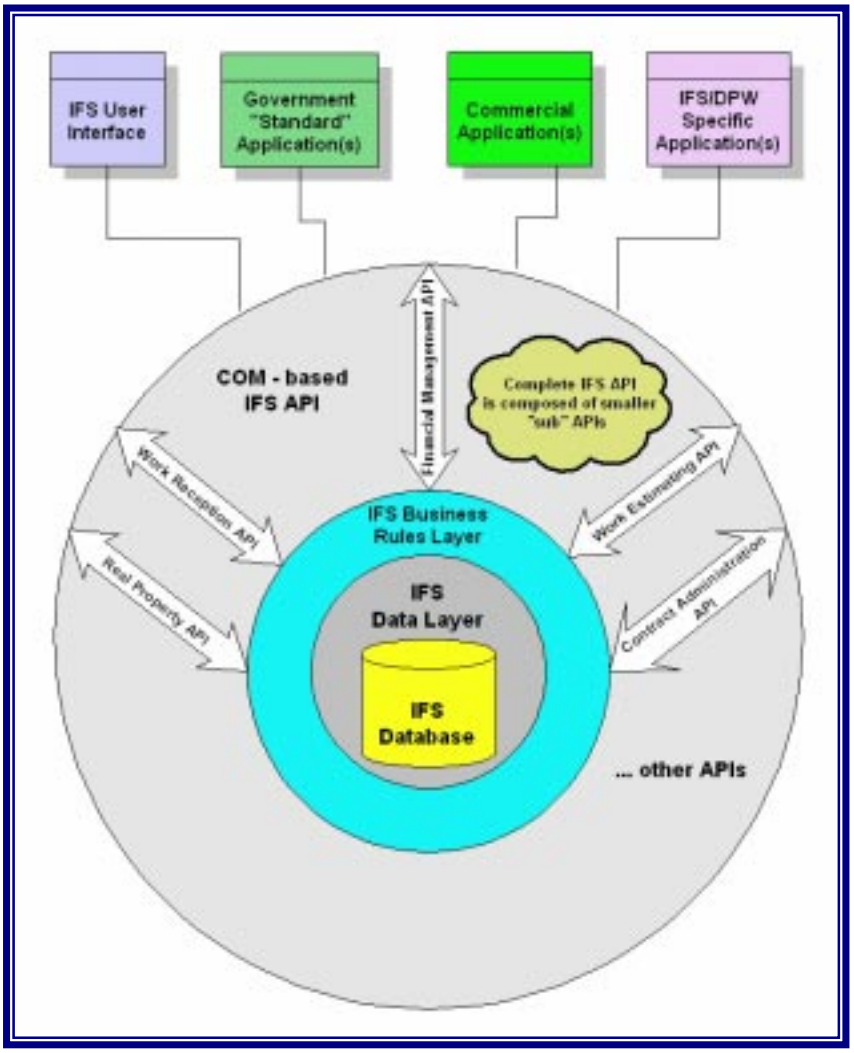
COM now provides the infrastructure to "do the job right." Using COM as a tool, applications can share data, procedures (i.e., business rules), and even user interface elements. It allows a single application to be subdivided into components for easier maintenance and updates. Componentization also facilitates Web-based deployment of the software.

While there are other object standards such as CORBA (Common Object Request Broker Architecture), COM is the most mature and widely available. Support for COM on Windows platforms is ubiquitous, and COM on Unix platforms is likely within the next 12 months. For current projects on the Windows platform COM is the obvious choice. However, there are other technologies of note that may have an impact in the future:

- CORBA (Common Object Request Broker Architecture) A direct competitor to COM. Currently less mature and less common.
- XML (eXtensible Markup Language) An extension to HTML and a complement to Java, XML is an emerging standard that includes specifications for sharing objects over the Internet

- Jini™ (from Sun® Microsystems, Inc.) Java™-based distributed computing model that provides the infrastructure for pervasive networking of myriad devices. Based on an open standard (Java) and is (almost) ready today.
- Microsoft is working on an as yet unnamed COM-based infrastructure to compete with Jini.

Successful creation of a COM-based API requires in-depth research of current and expected requirements and extensive analysis of those requirements, followed by an intensive design process with input and review from all parties involved. While these efforts can be expected to generate additional "up front" costs, such investments are usually offset by several economies further down the process stream:

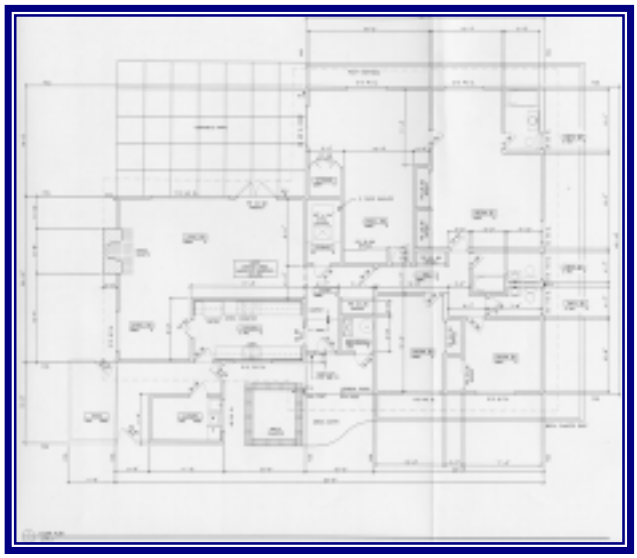


- Money saved in the implementation phase
- Money saved on maintenance and extension
- Increased chances of successfully completing software projects
- Better adherence to requirements--increased customer satisfaction
- Higher reliability and quality of the implemented software.

In short, the development of an API-based infrastructure for sharing data and functionality between IFS, COTS, and other government software will allow the strengths of all available applications to be leveraged. Taking advantage of existing capability in these applications allows new functionality to be added to IFS quickly and cheaply. Such speed and efficiency will be crucial to providing needed functional enhancements to IFS in a time frame more compatible with that of rapidly evolving DPW business practices.

Integrate IFS with CADD and GIS

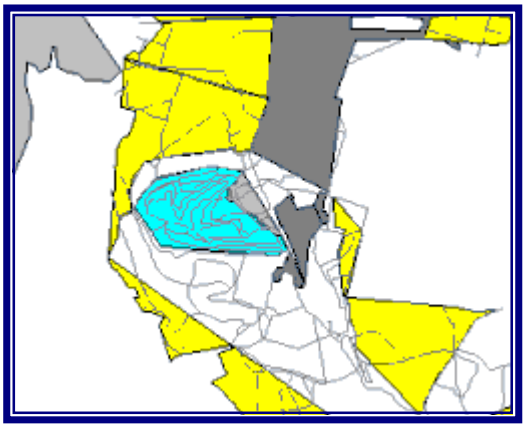
Provide the ability to view, analyze and interpret location-referenced IFS data using COTS computer-aided design and drafting (CADD) or geographic information systems (GISs).



The Integrated Facilities System (IFS) currently maintains a significant amount of data that is spatial in nature. Major improvements in facilities planning and analysis and in communication of facilities-related information can be made by integrating IFS with commercial, off-the-shelf (COTS) computer-aided design and drafting (CADD) systems and geographic information systems (GISs).

Within the U.S. Army Corps of Engineers and military installations, CADD is generally used to design and represent buildings and elements that are within five feet surrounding a given building. GISs are used for a more global picture, e.g., a GIS map might represent an entire installation and surrounding communities and show buildings, roads and parking lots, utilities, etc.

The integration of IFS with CADD and GIS software will, among other things, greatly improve the capability of DPWs to communicate within the DPW organization, and perhaps more importantly, with customers, contractors, privatization partners, interservice support agreement (ISSA) agencies, and government organizations at local, state and Federal levels. With CADD and GIS integration, distances, areas, volumes and thematic data are more easily communicated and correctly interpreted. The way maps and other data are stored as "layers" within a GIS allows one to relate information from IFS and many other different sources, making complex analysis and data modeling possible.



To help ensure system compatibility and usability, spatial data standards developed by the Tri-Service CADD/GIS Technology Center will be followed whenever possible.

When combined with World-Wide Web (WWW) technologies, the integration of CADD and GIS with IFS will offer all stakeholders of installation public works business processes easy access to new capabilities.

Introduce New Data Acquisition Methods

Provide the DPW the capability to acquire IFS data using several types of data collection devices.

"A device that reads brain waves through the skull has enabled paralyzed people to write sentences on a computer screen," reports New Scientist magazine's *Unlocking the Mind* article (16 Jan 1999). This technology is a bit premature to consider it anytime soon as a practical tool for gathering data. However, many proven commercial, off-the-shelf (COTS) technologies are available today that could be used in a Directorate of Public Works (DPW) environment to simplify data acquisition, improve data quality and enable some people with certain physical disabilities to perform certain tasks more easily.

Besides keyboard and mouse data entry at desktop personal computers (PCs), future Integrated Facilities System (IFS) releases will make widespread use of at least seven other data acquisition strategies:

- Bar coding
- Document scanning
- Pen computing
- Palm computing
- Handheld personal computer (H/PC) computing
- Computer telephony (CT) interactive voice response (IVR)
- Voice recognition

Bar coding is not new and today bar codes are used for many applications such as inventory control, pricing groceries and other consumer goods, mail addressing and shipping labels. Bar coding offers a cheap, fast, error free and reliable means of gathering data. IFS will employ this technology wherever possible, especially in conjunction with handheld portable computing devices to simplify data acquisition for those without easy access to a desktop computer. A new module planned for IFS, the Automated Labor and Equipment Card (ALEC) module, will utilize bar-code data entry.

IFS will allow document scanning as a means for data entry. Using low-cost, COTS desktop scanners and optical character recognition (OCR) software, information written on paper forms designed for use with IFS will be directly scanned and entered into the IFS database. Today, inexpensive OCR software packages typically capture text at 85%-95% accuracy and that rate will likely increase as technology continues to advance. Again, plans have been made for ALEC to accommodate document scanning.

Pen computing is a relatively new technology that might be used for IFS applications in lieu of document scanning. Like document

scanning, information is captured with ink on paper. However, with pen computing the paper form or tablet is mounted on a portable, digital notepad, i.e., a digital clipboard. An ink pen with a small, encased radio frequency transmitter sends pen stroke data to the digital notepad that's capable of storing approximately fifty pages of information. Hand-written text is converted to digital text and the digital information can be uploaded to a desktop computer via a communications ports. Pen computing software development kits (SDKs) are available in C++ and Java versions that provide the capability to custom create forms-processing applications that can feed information directly into IFS.

Palm computing hardware and software applications are rapidly gaining acceptance as efficient and effective tools that a mobile workforce can use for collecting and

managing data. Palm computers feature touch-sensitive screens designed to respond to a stylus. With the stylus a user can tap program icons to launch an application, select program menu options or make character pen strokes on the screen that in turn are converted to digital text. Palm computing tools are especially useful for those needing the ability to enter or access data while travelling or working at remote locations. Many DPWs are gradually being transformed into extended, virtual enterprises supported by mobile and geographically dispersed government and contract workforces that need easy access to network resources and computer software support. Application program interfaces (APIs) enable software developers to write custom, palm-computing applications. IFS modules may be written for use with palm computers. IFS data stored on the palm computers may later be synchronized with a DPW's IFS database of record, or updates may occur in real time via wireless Internet access.

Handheld Personal Computers (H/PC) computing is often viewed as an alternative to palm computing. Like palm computers, H/PCs are extremely small. The main functional difference between the two platforms is that H/PCs use a keyboard rather than a stylus for input.

User preferences will likely dictate which platform, palm or H/PC, should be used for various IFS applications where these technologies apply.

Computer telephony (CT) interactive voice response (IVR) systems use a database of prerecorded voice messages to present options to a user on the telephone. User input is made by pressing the touch-tone keypad of the telephone. IVR software applications may work with the IFS database server to allow for automated processing of service order requests and other data transactions.

Voice, or speech, recognition is the identification of spoken words by a machine. The spoken words are digitized, i.e., transformed into a sequence of numbers, and matched against digitally coded dictionaries in order to identify the words. Advances in speech processing algorithms and personal computer (PC) hardware technologies related to processing speed and random access memory (RAM) are primarily responsible for making voice recognition a viable contender for certain IFS data acquisition functions in the future.

Voice recognition systems may be classified as either *speaker independent* or *speaker dependent*. Speaker independent systems are designed to work for anyone without having to train them to a specific persons voice. Speaker dependent systems are trained to recognize a single persons voice and are most often used in the context of a specialized discipline like medicine where unique speech recognition vocabularies have been developed. Voice recognition systems may also be classified as *discrete speech* or *continuous speech* systems. Discrete speech systems require a pause between each word, while continuous speech systems recognize talk at a normal rate.

Today IFS users may benefit by using speaker-independent, discrete-speech systems when coupled with computer telephony IVR applications. For this type of application, several affordable COTS software packages exist that have well defined word vocabularies related specifically to IVR data processing. Aside from IVR applications, voice recognition technologies are still a bit premature to be used as a near-term solution for satisfying other IFS data acquisition requirements. Advances in the voice recognition technologies will be closely monitored for consideration in long-term data acquisition strategies for IFS.

Exploit Wireless Communication Technologies

Provide the DPW the ability to enter and view public works information remotely via wireless data networks.

Today it's common for many different agencies to provide Army installation base operations support. At a typical installation, the Directorate of Public Works (DPW), U.S. Army Corps of Engineers (USACE) District employees and hired contractors make up virtual teams that must frequently communicate and share information to ensure that the best customer service is achieved.

Recently, USACE chartered Installation Support Offices (ISOs) to serve as regional direct support elements for major Army commands (MACOMs), installation DPWs and other activities. The ISOs will offer technical public works, real property maintenance activities (RPMA) and operation and maintenance (O&M) guidance and services within their regional area of operations. As the ISOs mature, and as more base operations functions are let to contractors, a capability for all installation support personnel to access facilities management information stored in the Integrated Facilities System (IFS) when they're mobile will become even more valuable.

In the future, IFS will use wireless network communication technologies to meet mobile computing requirements. IFS users will be able to use notebook personal computers (PCs) or personal digital assistants (PDAs), i.e., palm computers or handheld PCs, from anywhere there is wireless data coverage.

Some wireless data carriers in the U.S. now have circuit-switched (CS) cellular digital packet data (CDPD) networks that offer statewide coverage for some states. CS-CDPD networks are relatively new and promise widespread and affordable wireless data communications, combining Internet protocol (IP) and circuit switched service. What this means for IFS users is that they will have remote connectivity to IFS and other resources on the corporate local area network (LAN).

The circuit-switched technology ensures that remote connectivity works seamlessly for the mobile user transitioning between wireless coverage areas so that the IP connection is never lost. Mobile units that support installation base operations will be able to access work schedules, order parts, check work orders, review maps and drawings stored electronically, enter work inspection information, etc., all from a mobile terminal.

Capitalize on Corporate Lessons Learned

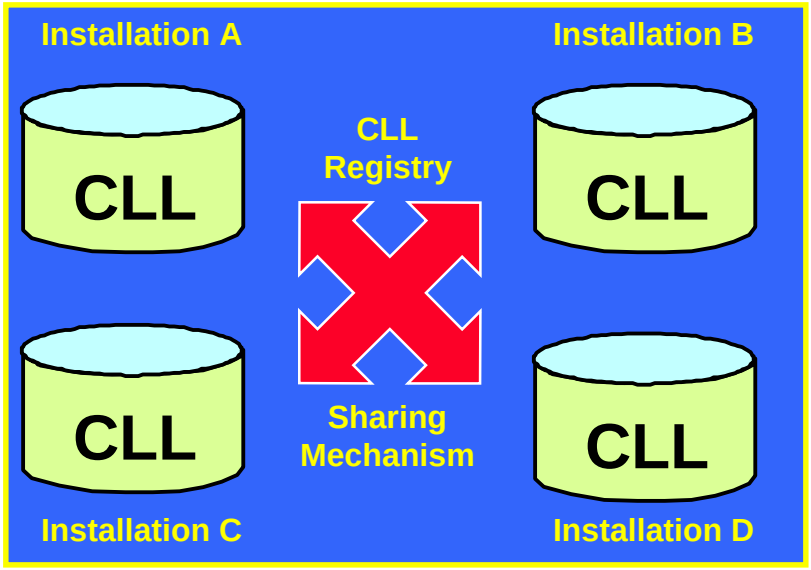
Provide IFS users an integrated capability to record and share task-specific lessons-learned throughout the Army.

Facility management employees continually improve their performance as they complete specific business processes such as work order processing, estimating, or inventory. While individual performance improves over time, the performance of the organization may not improve due to staff turn over or to the hand-off of work from one office to another. The essence of the Integrated Facilities System (IFS) Corporate Lessons Learned (CLL) is capturing an individual's knowledge about good work practices, success stories, and lessons learned and transforming that knowledge into a form that may be used by others working on the same type of project or those doing follow-on work.

Efforts to develop stand-alone systems to capture lessons learned have, eventually, collapsed due to the limited manpower that can ultimately be used to manage such systems. What is needed is a way to directly integrate the capture, evaluation, sharing, and use of organizational experience into existing business processes and systems. Only when existing systems are modified to capture those few additional pieces of data needed to translate the current situation into a "business case" that can be used in the future, will CLL be sustainable.

If the CLL architecture is designed correctly then existing government-developed and commercial, off-the-shelf (COTS) information systems, with slight modifications, will be able to deliver a locally sustainable CLL process. A sharing mechanism to allow locally developed and owned data to be shared with authorized others directly results from such a locally sustainable CLL process. The management trends from across the country may be identified and anticipated by automatically interrogating local CLL repositories.

When CLL is fully implemented, IFS will have an integrated, multidisciplinary, multi-process method of capturing, evaluating, retrieving, and using good work practices, success stories, and lessons learned. Specifically a process-specific, Web-based client-server architecture will be used to extract local organizational knowledge and share that knowledge globally to other IFS users.



Maintain IFS Customer Support WWW Site

Provide IFS users support for software and business processes via an IFS WWW site.

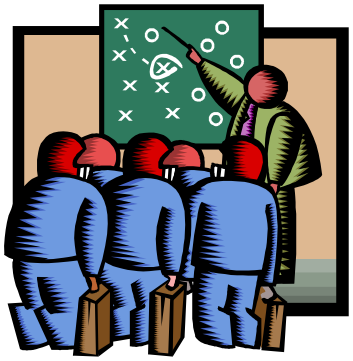
The Army is committed to providing the best customer support possible for Integrated Facilities System (IFS) users. In addition to the customer support services that exist today, a comprehensive World Wide Web (WWW) site for IFS is being developed that IFS users will be able to access for a host of services:

- Request help with IFS
- Check the status of a help request
- Share problem solutions with others
- Read about the latest IFS software version descriptions (SVDs)
- Obtain IFS Application Program Interface (API) documentation
- Browse customer-support knowledge bases
- Enter suggestions for IFS functional or user interface enhancements
- Obtain software updates for all IFS-related applications, both government-developed and commercial, off-the-shelf (COTS)
- Obtain device drivers for IFS-supported hardware
- Link to IFS-approved COTS software and hardware Web sites
- Read IFS newsletters
- Read periodic tips and hints on how to improve your business processes and use of IFS
- Obtain information regarding the interoperability relationships between IFS and other automated systems used by Army installations
- And other services.

A user-friendly interface will provide IFS customers intuitive access to these Web services. IFS customer support Web site visitors will eventually be able to register with the site. Once registered, a Web site visitor returning to the site will be uniquely recognized by the site. This "user awareness" feature of the Web site will further enhance Web site usability as each registered user will, to some degree, be able to customize their personal user interface for the site.

The IFS customer support Web site will enhance the performance of the IFS end-user and lessen the workload of the IFS technical support staff at installations.

IMPLEMENTING THE STRATEGY



The Army faces increasingly difficult choices in determining how scarce funding and other resources are allocated. Leaders of the Office of the Assistant Chief of Staff for Installation Management (OACSIM), the U.S. Army Corps of Engineers (USACE) Directorate of Military Programs Installation Support Division (ISD), the IFS Configuration Control Board (CCB), the USACE Engineer Research and Development Center (ERDC), and other Army agencies will use the Integrated Facilities System (IFS) Enterprise Strategy Principles as a guide for making tough resource allocation investment decisions regarding future IFS design and development.

The DPWs cannot rely on others to determine their functional requirements. DPWs must become more proactively involved in developing policies, standard business practices and IFS system design specifications and support plans. Members of some DPWs may elect to participate in IFS functional users groups or provide technology-needs statements to the IFS CCB via their major Army command (MACOM) representative. DPWs acting independently, or two or more DPWs in joint partnership, may elect to fund contractors or other government agencies to develop add-on software modules for IFS that would plug into the IFS open architecture.

As the IFS Strategic Plan becomes more fully implemented, third-party, Army-funded development of IFS add-on modules will likely become more common. To reduce the chance of coordination and system incompatibility problems, the IFS Program Manager will convene an IFS Technology Leadership Group (TLG). The IFS TLG will have four primary responsibilities:

- Evaluating new technologies
- Defining IFS system engineering technical specifications and future directions
- Providing technical oversight to third-party, Army-funded, IFS system development teams that undertake IFS-related development projects
- Ensuring that third-party system development efforts funded by the Army are conducted in the Army's best interests, with the Army maintaining certain rights to any software code developed.

The bottom line is that all IFS stakeholders must be committed to the vision presented in the IFS Enterprise Strategy and be willing to work cooperatively to establish, fund or execute an IFS Implementation Plan. Together the IFS Enterprise Strategy and Implementation Plan define the path that we will want to follow.

Questions? Comments?

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